

Bulletin of the Museum of Comparative Zoology

HARVARD UNIVERSITY

VOL. 132, No. 6

VARIATION AND NATURAL HISTORY OF
ELEUTHERODACTYLUS RUTHAE ON HISPANIOLA

BY ALBERT SCHWARTZ

CAMBRIDGE, MASS., U.S.A.

PRINTED FOR THE MUSEUM

APRIL, 1965



No. 6 — *Variation and Natural History of Eleutherodactylus ruthae on Hispaniola*

BY ALBERT SCHWARTZ

Eleutherodactylus ruthae Noble is one of the least known leptodactylid frogs of Hispaniola. Described first from the Peninsula de Samaná by Noble (1923), this shovel-suouted frog was later recorded by Dr. Cochran (1941:33) from several localities on the Samaná and from Jovero south of the Bahía de Samaná; these localities are all in eastern Hispaniola, and thus the distribution of *E. ruthae* was presumed to be extremely circumscribed.

In July, 1962, in the company of Ronald F. Klinikowski and David C. Leber, a very strange frog call was heard near Camp Perrin, in extreme southwestern Haiti near the tip of the Tiburon Peninsula. After much patience and persistence, the maker of this call was found, and the frog was at once recognized as *E. ruthae*. It was thus evident that the species must occur throughout much of Hispaniola, since the two areas whence it was now known were at diagonally opposite corners of the island. During the summer and early autumn of 1963, Messrs. Klinikowski and Leber, Richard Thomas and myself succeeded in collecting *E. ruthae* from several localities in the República Dominicana. Although we heard no frogs calling in the same voice as those from Camp Perrin, the voice of *ruthae* in any of its variations is usually recognizable as such, if for no other reason than its purely "different" quality and tonality. Thus with some awareness of the vocal proclivities of *ruthae* and with much perseverance, we managed to delimit the distribution of *E. ruthae* somewhat more fully, and succeeded in securing specimens from several interesting localities. I wish to thank Messrs. Klinikowski, Leber and Thomas for their enthusiastic pursuit of what can be extremely elusive and frustrating prey. Mr. Leber, who first unlocked the secret to *ruthae* collecting at Camp Perrin, also made the illustrations for the present paper; I wish especially to render my thanks to him for his work.

Strangely, nothing has been published on the habitat and life history of *E. ruthae*, although the Nobles apparently collected a large series of specimens on the Samaná, and Dr. W. L. Abbott's collector, John King, must likewise have been familiar with the habits of the frog. It is possible that in this area *E.*

ruthae has different habits than elsewhere, although just south of the Bahía de Samaná the frog's activities are typical.

As might be induced from the shovel-shaped snout, *E. ruthae* is a burrowing leptodactylid. Males call from underground chambers, apparently of their own manufacture; these chambers are completely roofed and smoothed inside, and there is no surface evidence of the existence of the burrow. Judging from our experience at Camp Perrin, the eggs are deposited in the same sort of burrow and hatch therein. I presume that the froglets escape from their chamber when rains soften the ground sufficiently for their departure. Thus, when collecting *ruthae*, each individual calling male must be tracked down; the area whence the call seems to proceed is cleared of trash and herbaceous cover, and the collector waits patiently for a repetition of the call, which at times is uttered at 20-minute or longer intervals. The call itself, which varies from place to place and will be described in detail below, is brief, and in a single sequence may be repeated only two or three times. During this short period, the collector must try to locate the source on the bare ground before him (assuming that he has not frightened the frog into silence by careless walking to the spot or careless clearing of the surface debris), and then begin poking the fingers into the ground. If luck is with him, and if he is persistent, and if the frog continues to call, and if he does not encounter stinging nettles, scorpions or other noxious flora and fauna, a finger may ultimately break through the roof of the chamber in which the male is calling. Upon contact, the frog usually utters a wheezy "wheep," and either crouches in the burrow or quickly escapes. It should be clear from the above that there are many instances of spending an hour trying to track down a calling male without success. The sport can be most discouraging. It is indeed a rewarding occurrence when one of these creatures is found sitting out in the open; insofar as we know, males rarely call from above ground, although in several instances males were heard to vocalize above ground. It is possible that males habitually call from above ground in some areas, but this has certainly not been our experience.

E. ruthae is a denizen of broad-leaf mesic forest. We have taken specimens, however, in a hillside pasture (which may originally have been forest adjacent to a lowland stream), a corn field and in upland pine woods. Near the latter locality the frogs were heard calling also from pastures in what had primitively been pine woods. Altitudinally, *E. ruthae* and a related species

described herein occur from sea level to at least 3500 feet in the Sierra de Baoruco. It is remarkable that these burrowing frogs are as yet unknown from the Massif de la Selle and Massif de la Hotte in Haiti, although both species occur on the southern slopes of the latter to at least 1000 feet at Camp Perrin. One requirement for the habitat is moisture; another is a friable loamy soil which is not sandy. Forests where *E. ruthae* has been taken are usually fairly open; the frogs make their burrows in the open, and only once did I encounter a *ruthae* in a burrow adjacent to a log. However, they must on occasion live beneath rocks or logs, since twice natives brought us specimens of *ruthae* which they had taken while searching for snakes and geckos. In the Sierra de Baoruco, the call of the species related to *E. ruthae* was an important and conspicuous part of the amuran chorus after rains; individuals were collected here with relative ease in open coffee groves, and one was taken within two feet of the paved highway in the road shoulder. Although an afternoon rain enhances the chances of finding *E. ruthae*, males often call sporadically at night after dry days. Under these circumstances finding the frog which is calling hesitantly and intermittently is a real project, and success is extremely doubtful.

As in many burrowing animals, the likelihood of geographic variation in *E. ruthae* seemed very great. "Colonies" may be widely separated, and I imagine that the home range of these frogs is rather restricted. I have no idea how the female finds the male, or how she enters the burrow of the male, if she does. That the eggs are laid below ground is assumed from the fact that a nursery burrow was found by Mr. Leber at Camp Perrin. At the insertion of his finger, at least eighteen hatchlings jumped forth and were taken. Although we have a large and adequate series from only one locality (there are also available many specimens from the Samaná), study of all the material shows that there is indeed variation in size, proportions, coloration and pattern between various populations in Hispaniola. The total material is inadequate in many ways, but in certain regards the differences are quite obvious and distinct. I cannot outline the ranges of the forms except in the most tentative and general terms, based upon my knowledge of the geography of the island. Additional material may be slow in coming, but it will be interesting to ascertain what the entire distribution of *E. ruthae* eventually will prove to be.

Since females are encountered above ground, and merely by chance, they are rare in collections. In the present series of specimens, there are only six females, all from within the range of the nominate form. These specimens are discussed under *Eleutherodactylus ruthae ruthae*; descriptions of all other races are based exclusively on males. The differences between the sexes are very small although females reach slightly larger snout-vent length, have greater head length and width, greater tympanum diameter, greater naris to eye distance, longer femur, tibia and fourth toe. It is thus probable that the characters proposed for the new subspecies will occur in females as well as in the paratype males. One wonders if the similarity in size between the sexes of *ruthae*, a condition which is unusual in West Indian *Eleutherodactylus*, is correlated with their habits.

In addition to specimens collected by myself and party (ASF'S), I have borrowed material from the following collections: Dennis R. Paulson (DRP), Richard Thomas (RT), Charles M. Bogert and Margaret Bullitt, American Museum of Natural History (AMNH), the late Norman E. Hartweg and Charles M. Walker, Museum of Zoology, University of Michigan (UMMZ), Doris M. Coehran, United States National Museum (USNM), and Ernest E. Williams, Museum of Comparative Zoology (MCZ). I wish to acknowledge the cooperation of all the above persons in allowing me to study material in their care. Paratypes have been deposited in the Museum of Natural History, University of Kansas (KU), as well as in some of the above collections.

The population of *Eleutherodactylus ruthae* from extreme eastern Hispaniola, including the Península de Samaná whence the frog was described, is distinctive and may be defined as follows:

ELEUTHERODACTYLUS RUTHAE RUTHAE Noble, 1923

Definition of Subspecies: A moderate sized, shovel-snouted *Eleutherodactylus* with a dorsal pattern of spots and usually with some inter-spot mottling or marbling, lores dark with a paler vertical preocular bar and a dark canthal stripe; concealed surfaces of thighs more or less uniformly speckled light on a dark background, a single band present across the antebrachium, small digital discs, and a tibia/snout-vent ratio of 51.3 to 57.9 per cent in males.

Specimens Examined: República Dominicana, Samaná Province: Samaná and Laguna, 7 (UMMZ 92208; USNM 65714-15, 65717-20); Samaná, 11 (AMNH 20917-18; AMNH 31362-70); Río San Juan, 3 (USNM 74597-99); Península de Samaná, 5 (USNM 66767-69, 66978-79); El Seibo Province: 1.4 mi. (2.2 km) SE Miches, 2 (ASFS X9335-36); Jovero, 3 (USNM 65710,



FIG. 1. *Eleutherodactylus ruthae ruthae*, ASFS V967, adult female from 0.5 mi. (0.8 km) NW Boca de Yuma, La Romana Prov., República Dominicana; snout-vent length 47.8 mm.

65713; MCZ 25719); La Romana Province: 2.4 km NW Boca de Yuma, 1 (ASFS V1039); 0.5 mi. (0.8 km) NW Boca de Yuma, 5 (ASFS V942; ASFS V967-70).

Measurements (means and extremes, in millimeters) of 30 males: Snout-vent length, 45.3 (39.6 - 50.0); head length to posterior border of tympanum, 17.8 (16.1 - 19.3); greatest width of head, 19.3 (18.0 - 21.1); longitudinal diameter of tympanum, 3.6 (3.2 - 4.0); longitudinal diameter of eye, 5.9 (5.3 - 6.8); naris to eye, 5.5 (4.8 - 6.7); femur, 22.4 (19.1 - 25.2); tibia, 24.5 (22.0 - 26.7); fourth toe, 20.1 (17.6 - 22.4); tibia/snout-vent length, 53.9 per cent (51.3 - 57.9 per cent). The same measurements for five females are: snout-vent length, 48.8 (46.8 - 52.3);

head length, 18.8 (17.6 - 19.9); head width, 21.0 (19.9 - 21.9); tympanum, 3.8 (3.4 - 4.1); eye, 6.2 (5.8 - 6.6); naris to eye, 5.8 (5.5 - 6.2); femur, 23.4 (21.7 - 25.5); tibia, 26.4 (24.8 - 27.4); fourth toe, 21.6 (20.6 - 23.9); tibia/snout-vent ratio, 54.0 (51.7 - 55.7).

Coloration and Pattern: The drawing of *E. ruthae* in Dr. Cochran's *Herpetology of Hispaniola* (1941:31) shows the pattern of the nominate form; another illustration is included in the present paper (Fig. 1). Both show the typical pattern for *E. r. ruthae*. The dorsum varies from pinkish buff to a rich dark brown, with all dorsal spots black, and often outlined by a faint pale pinkish to tan line. The interspaces between the dorsal spots are always marbled or mottled with a darker hue, and the dorsal spots and dorsal interspace mottling are continuous onto the sides. A fine glandular dorsolateral ridge is often set off by a fine pale line. The interocular bar is sharp-edged and straight anteriorly, scalloped and somewhat diffuse posteriorly. There is a single antibrachial band which in this subspecies is not set off from the remainder of the dorsal arm mottling by a pale line. The lores are dark, with a diffuse pale preocular bar or blotch, and the canthus rostralis is marked by an even darker brown line. A black semicircle proceeds from the posterior border of the eye, crosses the upper edge of the tympanum and progresses ventrad to a warty area at the angle of the jaw; this warty area in life is crossed horizontally by a bold and bright broad yellow line. The upper surfaces of the hindlimbs are crossed by dark brown transverse bars, from three to four bars on the crus, and from three to six on the thigh. The concealed surfaces are heavily dotted with pinkish buff to creamy tan to orange, on a ground color of rich brown. Some specimens show shadow-bars on the upper surfaces of the hind limbs and some do not; the modal condition is: shadow-bars present but inconspicuous. Ventrally, the ground color is creamy with the margin of the lower jaw always speckled with dark brown; there are specimens with the throat likewise stippled, and occasionally there are a few dark flecks on the pectoral region or even the lower sides and onto the venter. The digital discs are small, that of the second finger equalling a bit less than one-quarter of the tympanum.

Observations: I have not collected specimens of *E. r. ruthae* from the Península de Samaná; calling males were collected by us at the Miches and Boca de Yuma localities. At Miches,

the call was one of two variations on a two-note guttural call, almost a pair of loud grunts, with the second note either higher or lower than the first. This pair of notes was at times preceded by a warm-up grunt, sounding much like "whup." At Boca de Yuma, the call was a series of five to eight ascending "brrrp"'s, each about one note higher than the former, and uttered rather deliberately and not in a rapid *glissando* fashion. At Miches, one male was taken calling under a very small heap of trash in a cornfield, about five feet from its edge, and the other was on a bank in a gully adjacent to the corn field under dry leaves among herbs. At Boca de Yuma, one male was calling from a burrow adjacent to a small limestone sinkhole; two more were found calling in underground cavities in broad-leaf forest on a limestone ridge. At this same locality, a frog was taken crossing the paved road after a nocturnal deluge, another one foot above the ground in a *Bryophyllum* thicket, and a female was brought to us by natives, who presumably found it while turning logs or rocks looking for snakes.

Despite the apparent differences in call between Miches and Boca de Yuma males, I cannot differentiate them structurally or chromatically from one another nor from topotypical material. Since neither of the two calling males from Miches was taken in an underground burrow, and since, additionally, Thomas and myself heard a two-note call at Boca de Yuma from a frog which was perched in herbaceous cover one foot above the ground surface, I wonder if the two-note grunt heard at Miches is an above-ground call, which possibly differs from the more "typical" five to eight note subterranean call. Without information on the call of Samaná males, it is impossible to generalize about the call throughout the entire range of this subspecies. Variability in call structure is not unknown in *Eleutherodactylus*; the best known example is the call of *Eleutherodactylus pantoni* in Jamaica (Lynn and Dent, 1943).

Two specimens of *E. ruthae* from the western end of the Tiburon Peninsula in Haiti are distinct from the populations from extreme eastern Hispaniola, and may be named, in reference to the practical impossibility of collecting this subspecies:

ELEUTHERODACTYLUS RUTHAE APOSTEGUS new subspecies

Holotype: MCZ 43186, an adult male, from Camp Perrin, Dépt. du Sud, Haiti, collected by David C. Leber, 23 July 1962. Original number X2796.

Paratype: ASFS X2713, Camp Perrin, Dépt. du Sud, Haiti, 23 July 1962, collected by a native.

Diagnosis: A subspecies of *E. ruthae* distinguished from the nominate form by a combination of larger size, low tibia/snout-vent ratio (49.2 to 50.3 per cent), very small digital discs, a distinct, vertical, pale preocular bar, throat marbled with black, dorsal spotting reduced with clear dorsal interspaces, posterior faces of thighs with large pale areas and a black reticulum, rather than a dark background with individual pale dots as in *ruthae*.

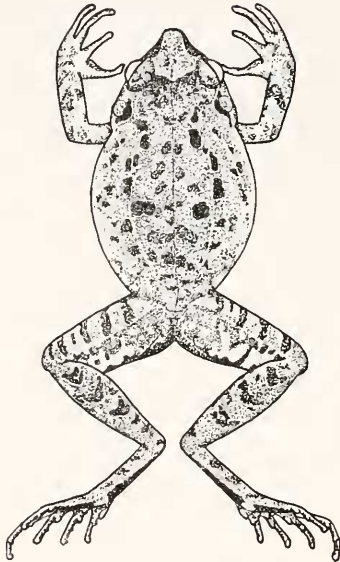


FIG. 2. *Eleutherodactylus ruthae aporostegus*, MCZ 43186, type, adult male from Camp Perrin, Dépt. du Sud, Haiti; snout-vent length 47.8 mm.

Description of Holotype: Snout-vent length, 47.8; head length, 18.6; head width, 20.0; tympanum, 3.8; eye, 6.5; naris to eye, 5.8; femur, 22.2; tibia, 23.5; fourth toe, 20.0; tibia/snout-vent length, 49.2 per cent.

Head broader than long; snout very acute and slightly declivous with nares inconspicuous at anterior end of canthus rostralis; lores concave; diameter of eye greater than distance from naris to anterior corner of eye; interorbital space 6.6 mm, about equal to diameter of eye; diameter of tympanum much less than

diameter of eye, distance from tympanum to eye equal to about one-quarter diameter of tympanum. Digital discs present, very small, that of digit two the largest and equal to about one-eighth the size of the tympanum. Fingers relatively long, unwebbed, 2-4-1-3 in order of decreasing length. Toes long, unwebbed except for a vestigial web between toes four and five, 4-3-5-2-1 in order of decreasing length on right foot; left foot deformed. Heels do not touch when hindlimbs held at right angles to body axis. Dorsum finely rugose with a raised median line and slightly raised very narrow dorsolateral folds; a group of warts at angle of jaw with a pale low ridge above. Throat and chest smooth; belly smooth to faintly granular; no vocal sac indicated or inflated; abdominal disc fairly prominent, delimited anteriorly and posteriorly by pectoral and posterior abdominal transverse folds. Posterior surface of thigh with many small flattened juxtaposed granules.

Vomerine teeth in two short, almost transverse rows, separated from each other by a distance equal to about one-quarter of the length of one row. Internal choanae irregularly placed, the right more anterior and more lateral than the left. Left choana normal, the left vomerine row reaching barely to the level of the inner margin of the choana and separated from it by a distance equal to the diameter of the choana. Tongue large, ovoid, entire, free behind, and equal to about one-half the floor of the mouth in area.

Dorsum in life pale reddish tan with a pattern of both blackish-brown and gray spots; by this difference in spot coloration some spots are more prominent than others (see Fig. 2), as follows. There is a pair of dark brown scapular crescents which are fragmented and have their apices pointing laterally; a pair of dark sacral spots, and a single irregular tripartite blotch on the midline between the sacral spots and the vent. All the remaining dorsal and lateral spots are dull gray, and thus not prominently in contrast to the ground color as are the darker spots mentioned above. The interblotch areas of the dorsum lack any pronounced marbling; the interocular bar is gray and like the pale dorsal spots in color. The lores are clouded with a darker hue, and there is a prominent vertical bar (bright orange in life) or blotch before the eye; the supratympanic line is black and short, not outlined in white. The thighs have four to five narrow dark transverse bars, which are paler centrally, and the crura have three or four bars which are

likewise narrow and washed out centrally. The concealed surfaces were pale yellow in life with a black to gray reticulum, darker along the posterior edge of the thigh. The soles of the feet are dark gray, the subarticular tubercles moderately prominent and gray, the outer metatarsal tubercle low and obscure, as is typical of all subspecies of *E. ruthae*. There is a single antebrachial bar and faint indications of a wrist bar as well, but all forelimb markings are rather obsolescent. Ventral color pale cream in life, with definite gray marbling (rather than stippling) on the chin. Underside of limbs dark brown, forming a sharp line along the lateral faces of the crus and antebrachium; underside of thigh and brachium more or less marbled with dark and light, most intense toward the knee in the former.

Variation: The single male paratype has the following measurements and ratio: snout-vent length, 47.1; head length, 18.2; head width, 20.6; tympanum, 3.5; eye, 6.7; naris to eye, 5.8; femur, 20.7; tibia, 23.7; fourth toe, 20.0; tibia/snout-vent length, 50.3 per cent. The paratype is even more strikingly marked than the type; the dorsal ground color in life was reddish brown. All blotches except the scapular crescents (which are entire), the sacral spots, the supratympanic line, and one spot on each side adjacent to the sacral spots, are much reduced and represented only by diffuse pale gray areas. The interorbital bar is obsolescent. The hindlimbs are marked as in the type, but the bars are even more hollowed centrally and the shadow-bars are much more reduced, as is the antebrachial bar. The ventral patterns are comparable, although the paratype has somewhat less marbling on the chin and throat. The pattern on the concealed surfaces is identical; the pale areas on the posterior face of the thighs, the axilla, and groin were all yellow-orange in life. The iris was dark brown. The paired vocal sacs are inflated and are supra-axillary in position.

Comparisons: *E. r. aporostegus* differs from *E. r. ruthae* in coloration and pattern. In effect, *aporostegus* is *ruthae* with part of the dorsal pattern blanched, thus placing in prominence the scapular crescents, the sacral spots, and some lateral spots — all of which are present in *r. ruthae* but are not outstanding on the spotted dorsum wherein all spots and markings are of the same intensity of pigmentation. The marbled (rather than dotted) concealed surfaces, and the marbled (rather than stippled) chin and throat also will distinguish *aporostegus* from *ruthae*.

In size, *aporostegus* is larger than *ruthae* in all measurements except the three hindlimb measurements, which are smaller than average for *r. ruthae*. The larger eye (mean 6.6 for *aporostegus*, 5.9 for *ruthae*) is especially noteworthy. Measurements of femur, tibia, and fourth toe all are less in *aporostegus*, with fourth toe being the least different. The difference in tibia length between the two forms is expressed in the tibia/snout-vent ratio, which averages 53.9 per cent for *ruthae* and 49.8 per cent for *aporostegus*. There is at present no overlap in the extremes of this ratio between the two subspecies.

Observations: The taking of the type of *E. r. aporostegus* was outlined in the introduction to the present paper. After tracking down the "whoop-whoop-whoop" call to a grassy hillside adjacent to a slowly flowing stream, the male was finally located in its small subterranean chamber. The paratype was brought us by natives, who doubtless had happened upon it by chance under an overturned log or rock. Eighteen juvenile *E. r. aporostegus* were also collected by Mr. Leber at Camp Perrin; these hopped from an underground cavity when the roof was broken in by chance at night after a moderate rain. This cavity was on the same grassy hillside as the cavity of the type. The juveniles are colored like the adults, but had the snouts and the dorsolateral lines bronzy and very distinct in life.

A single specimen from west central República Dominicana is so different in size and proportion from the two preceding races that I have no hesitancy in describing it as new, despite its uniqueness. The frog was taken from what is possibly one of the least known areas of the República Dominicana, and apparently *E. ruthae* is not common in this region. For this subspecies, since the type was finally collected by chance after much patient search, I propose the name:

ELEUTHERODACTYLUS RUTHAE TYCHATHROUS new subspecies

Holotype: MCZ 43188, an adult male from 7 km northwest Vallejuelo, 2600 feet (790 m), San Juan Province, República Dominicana, collected by Ronald F. Klinikowski, 17 August 1963. Original number V528.

Diagnosis: A subspecies of *Eleutherodactylus ruthae* characterized by a combination of very large size, relatively short tibia, low tibia/snout-vent length ratio (46.3 per cent), very large tympanum, and concealed surfaces extensively dark brown with scattered cream dots.

Description of Holotype: Snout-vent length, 57.8; head length, 20.9; head width, 20.2; tympanum, 4.5; eye, 6.5; naris to eye, 6.4; femur, 24.6; tibia, 26.8; fourth toe, 24.5; tibia/snout-vent length ratio 46.3 per cent.

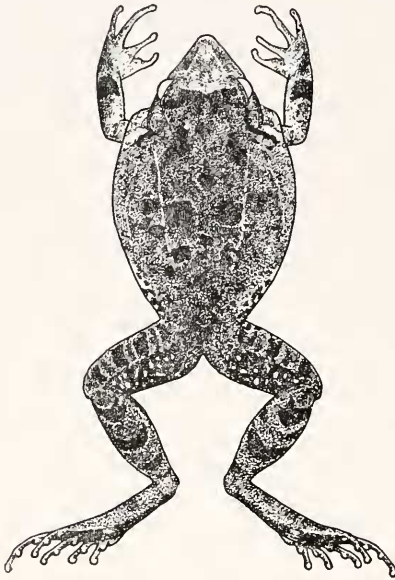


FIG. 3. *Eleutherodactylus ruthae tychathrous*, MCZ 43188, type, adult male from 7 km NW Vallejuelo, San Juan Prov., República Dominicana; snout-vent length 57.8 mm.

Head slightly longer than broad; snout very acute with nares inconspicuous at anterior end of canthus rostralis; lores concave; diameter of eye equal to distance from naris to anterior corner of eye; interorbital space 6.3, slightly less than diameter of eye; diameter of tympanum much less than diameter of eye, distance from tympanum to eye equal to about one-quarter diameter of tympanum. Digital discs present, small, that of digit two the largest and equal to about one-seventh the size of the tympanum. Fingers relatively long, unwebbed, 2-1-4-3 in order of decreasing length. Toes long, unwebbed except for a vestigial web between toes three and four, 4-3-5-2-1 in order of decreasing length. Heels touch when hindlimbs held at right angles to body axis. Dorsum very finely rugose, practically

smooth with fine raised dorsolateral and median lines, and short diagonal lines starting from behind the tympanum and proceeding ventrolaterally down the side for about one-half the length of the dorsolateral lines. Throat and chest smooth; belly smooth to faintly granular; vocal sacs inflated and large, supra-axillary in position; abdominal disc fairly prominent, its pectoral margin obscure, its abdominal fold fairly conspicuous. Posterior surface of thigh with many rounded granules.

Vomerine teeth in two short, straight transverse rows, separated from each other by a distance equal to about one-quarter of the length of one row, extending laterally at least midway across the opening of the internal choana, and separated from the choana by a distance equal to twice the diameter of a choana. Tongue small, oval, very slightly nicked, free behind, and equal to about one-half the floor of the mouth in area.

Dorsum in life dark brown with a pattern of darker brown spots, all of equal darkness and none suppressed or obsolescent; snout grayish tan, interocular bar dark brown and sharp-edged anteriorly and blending into the dorsal ground color posteriorly; dorsolateral thin ridges yellow in life; interblotch area of dorsum without marbling or mottling (Fig. 3). Lores dark brown with a pale preocular blotch or bar, which is not conspicuous; supratympanic line black and long, not outlined above with white and passing above the posttympanic yellow bar. Thighs with three dark transverse bars, and crura with three dark, rather angled bars; shadow-bars not especially prominent. Concealed surfaces uniform dark brown with widely separated and discrete cream dots. A single antibrachial bar which is prominent and no indication of a wrist bar. Ventral color pinkish in life with dark stippling on the lower jaw, chin and throat, as well as some isolated stippling on the belly and chest. Underside of forelimbs dark brown; underside of hindlimbs dark brown mottled with pinkish, the brown pigment on the thigh concentrated distally and the crus being almost uniformly mottled. Iris was very dark brown in life.

Comparisons: The single specimen of *tychathrous* differs from both *ruthae* and *aporostegus* in tibia/snout-vent length ratio (see Fig. 8); no other specimen even approaches this figure closely, although the two specimens of *aporostegus* have the lowest ratio of all other races. The greater snout-vent length is also apparent. The long body and short hindlimbs are quite obvious when the type of *tychathrous* is compared directly with specimens of the other forms. The greater size of the tympanum is

likewise apparent. In having small digital discs, *tychathrous* resembles both *ruthae* and *aporostegus*, but differs from the latter in having a uniform and unfaded dorsal pattern and from the former in pattern of the concealed surfaces.

Observations: The type of *tychathrous* was taken at night while it was calling from among rocks in the wooded flood-plain of a small river. Messrs. Klinikowski and Leber had spent some time in tracking down an individual but did not succeed in collecting it, although the burrow was discovered and the frog disturbed. After waiting for some time, a frog began to call from among a pile of rocks, and it is possible that this was the original frog which had been calling from the burrow. The call itself is made up of four ascending syllables, similar to the Haitian three-note series of "whoops," but the last two syllables are slowly trilled and more or less on the same pitch. It is probable that the call of *tychathrous* is a modified *aporostegus* call, with the final *aporostegus* note duplicated instead of single, and trilled rather than "whooped."

In the upland pine forests on the northeastern slope of the Cordillera Central, three specimens of *E. ruthae* were taken which represent a fourth subspecies; this race, in reference to its underground calling, may be called:

ELEUTHERODACTYLUS RUTHAE BOTHIROBOANS new subspecies

Holotype: MCZ 43189, an adult male, from 12 km northeast of Jarabacoa, 2100 feet (640 m), La Vega Province, República Dominicana, collected by Richard Thomas, 31 October 1963. Original number V1945.

Paratypes: ΔSFS V1946-47, same data as holotype.

Diagnosis: A subspecies of *Eleutherodactylus ruthae* characterized by a combination of moderate size, dark dorsal coloration with interblotch area irregularly marbled, heavy ventral stippling, distinctive concealed surface pattern, and moderately well developed digital discs.

Description of Holotype: Snout-vent length, 48.8; head length, 18.4; head width, 21.0; tympanum, 3.7; eye, 6.1; naris to eye, 5.3; femur, 23.6; tibia, 24.7; fourth toe, 24.7; tibia/snout-vent ratio, 50.6 per cent.

Head broader than long; snout very acute with nares inconspicuous at anterior end of canthus rostralis; lores concave; diameter of eye greater than distance from naris to anterior corner of eye; interorbital space 5.9, slightly less than diameter

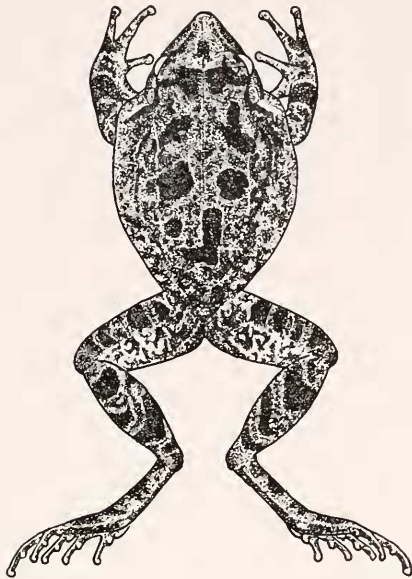


FIG. 4. *Eleutherodactylus ruthae bothroboans*, MCZ 43189, type, adult male from 12 km NE Jarabacoa, La Vega Prov., República Dominicana; snout-vent length 48.8 mm.

of eye; diameter of tympanum much less than diameter of eye, distance from tympanum to eye equal to about one-third diameter of tympanum. Digital discs present, moderate in size, that of digit two the largest and equal to about one-half the size of tympanum. Fingers relatively long, unwebbed, 2-1-4-3 in order of decreasing length. Toes long, unwebbed, 4-3-5-2-1 in order of decreasing length. Heels overlap strongly when hindlimbs held at right angles to body axis. Dorsum almost smooth, sides heavily rugose; slightly raised median, dorsolateral and oblique lateral folds; a group of warts at angle of jaw with a pale and low ridge above. Throat and chest smooth; belly smooth centrally, and granular laterally; vocal sacs slightly inflated and supra-axillary in position; abdominal disc clearly delimited anteriorly and posteriorly by fairly prominent pectoral and abdominal folds. Posterior surface of thighs with many rounded juxtaposed granules.

Vomerine teeth in two short, almost transverse rows, separated from each other by a distance equal to about one-third the

length of one row, their lateral ends overlapping the choanae and separated from them by a distance equal to the diameter of one choana. Tongue large, ovoid, entire, free behind, and equal to about one-half the floor of the mouth in area.

Dorsum in life rich reddish brown with darker brown spots. Typical suprascapular spots present but diffuse, the postsacral area with an asymmetrical reversed L-shaped blotch. Blotch interspaces much mottled and clouded with darker brown pigment. Snout slightly paler than the remainder of the dorsum, and set off from it by the anteriorly sharp-edged interocular bar, which is diffuse posteriorly. Lores dark, lacking a prominent preocular light bar or blotch, but with a small pale line just anterior to the eye; supratympanic line dark brown and not outlined above with white. Thighs with four bold dark transverse bars, erura with three or the remnants thereof; shadow-bars prominent, the limbs very contrastingly and vividly marked. Concealed surfaces dark brown centrally, laterally showing pink heavy blotching, with more light than dark area involved (Fig. 4). Soles of the feet very dark gray. A single antebrachial bar which is rather conspicuously set off from the ground color by pale outlining. Ventral color cream in life, with heavy dark brown stippling on the lower jaw, chin and throat, pectoral region and venter. Underside of the hindlimb dark brown, marbled with cream, the dark brown pigment continuing onto the distal portion of the underside of the thigh.

Variation: The two paratype males and the type have the following measurements: snout-vent length, 46.3 (43.5-48.8); head length, 17.9 (16.8-18.4); head width, 20.0 (18.9-21.0); tympanum, 3.6 (3.4-3.7); eye, 6.0 (5.7-6.1); naris to eye, 5.2 (5.1-5.3); femur, 23.0 (21.9-23.6); tibia, 24.3 (23.3-25.0); fourth toe, 21.1 (20.1-21.7); tibia/snout-vent ratio, 52.6 per cent (50.6-53.6 per cent). In life the series was reddish brown to dark brown dorsally, with the appearance of the dorsal spots dependent upon the intensity of the ground color. In all, the legs are heavily banded, with prominent shadow-bars, and the ventral ground color is creamy with heavy stippling on the lower jaw, throat, and belly. The two paratypes have the scapular crescents more well defined than the type, and also have a more orthodox postsacral round blotch, rather than the L-shaped blotch of the type in this region. The digital discs are all moderately large. The vocal sacs are slightly inflated in one paratype and more inflated in the other. The

concealed surfaces are as described for the type — dark medially and with much light vermiculation and confluence of pink blotches laterally.

Comparisons: From *E. r. aporostegus*, *bothroboans* differs in having a very dark rather than very light dorsum, a heavily stippled venter rather than only a marbled throat, large digital discs, and a higher tibia/snout-vent ratio; the latter will presently separate the two races. *E. r. tychatrous* is much larger than *bothroboans*, with a much shorter tibia and lower tibia/snout-vent ratio, has small digital discs and a dotted concealed surface pattern. From *E. r. ruthae*, *bothroboans* differs in having moderately enlarged digital discs, a much stronger dorsal pattern, and a different concealed surface pattern. Apparently these two subspecies are comparable in size, although *ruthae* averages slightly smaller than *bothroboans*; the tibia/snout-vent ratios of the two are comparable.

Observations: The three *bothroboans* were all collected while calling from underground cavities in open pinewoods; the call is a series of five to eight “wherp”’s, each “wherp” with a slight ascending inflection, but the whole series on about the same tone. The population at the type locality was not concentrated and the frogs seemed to be rather widely scattered throughout the area; elsewhere, several were heard close to the town of Jarabacoa and others between the type locality and La Vega, at an elevation of 1400 feet (440 m).

In the Sierra de Baoruco, between the crest of the ridge to the north of Polo and Las Auyamas, we encountered a burrowing frog which is related to *E. ruthae* and which we regarded at the time as another very distinct subspecies of the latter. However, there are specimens of this frog also from the mountains north of Les Cayes (Massif de la Hotte), in the general vicinity of Camp Perrin, where *E. r. aporostegus* occurs. It is probable that this new species occurs throughout much of the length of the La Hotte-La Salle-Baoruco massif, perhaps not at extremely high elevations, and that it has been overlooked in the region between the Sierra de Baoruco and the extreme western La Hotte. Because of the apparent proximity of specimens of this form and of *E. r. aporostegus* in the vicinity of Camp Perrin without any indication of intergradation, and because of certain structural and pattern features which differentiate the two, I propose that this new form be regarded as a full species and be called, in allusion to its underground calling:

ELEUTHERODACTYLUS HYPOSTENOR new species

Holotype: MCZ 43187, an adult male, from 10.5 mi. (16.8 km) S Cabral, 3500 feet (1060 m), Barahona Province, República Dominicana, one of a series collected by David C. Leber, Albert Schwartz, and Richard Thomas, 1 August 1963. Original number V39.

Paratypes: ASFS V40-49, AMNH 71936-37, MCZ 43190-91, KU 79768-69, USNM 150723-24, RT 758-59, DRP 2898, all with same data as type; ASFS X9797-800, 1.8 mi. (2.8 km) N Las Auyamas, 3400 feet (\pm 1035 m), Barahona Prov., República Dominicana, D. C. Leber, A. Schwartz, R. Thomas, 26 July 1963; ASFS X9790, 0.6 mi. (0.9 km) N Las Auyamas, 3000 feet (914 m), Barahona Prov., República Dominicana, D. C. Leber, 26 July 1963.

Associated specimens not designated as paratypes: MCZ 36511, Haiti, Dépt. du Sud, mountains north of Les Cayes; AMNH 44074, 44079, Haiti, Dépt. du Sud, 25 mi (40.2 km) N Les Cayes.

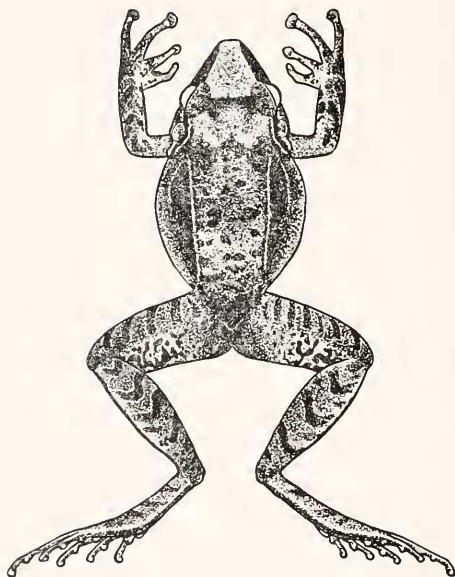


FIG. 5. *Eleutherodactylus hypostenor*, MCZ 43187, type, adult male from 10.5 mi (16.8 km) S Cabral, 3500 feet (1060 m), Barahona Prov., República Dominicana; snout-vent length 54.4 mm.

Diagnosis: A species of *Eleutherodactylus* related to *E. ruthae* and *E. inoptatus*, and distinguished by a combination of large size, high tibia/snout-vent ratio (55.7 to 61.3 per cent), very large digital discs, unicolor dark brown and flat (rather than concave) lores, stippled chin and throat, dorsal pattern a middorsal zone enclosed between two dorsolateral lines, set off strongly from much darker lateral coloration, and with dorsal spots much obscured or absent, posterior faces of thighs dark centrally and with pale vermiculations or vertical bars (never dots) laterally, a pair of chevron-like antibrachial bars, supratympanic black bars outlined above with white, a more truncate and less overhanging snout, and absence of external vocal sacs.

Description of Holotype: Snout-vent length, 54.4; head length, 20.1; head width, 22.2; tympanum, 4.0; eye, 7.0; naris to eye, 7.0; femur, 26.3; tibia, 31.0; fourth toe, 25.5; tibia/snout-vent ratio, 57.0 per cent.

Head broader than long; snout acute but truncate with nares inconspicuous at anterior end of canthus rostralis; lores flat; diameter of eye equal to distance from naris to anterior corner of eye; interorbital space 6.2 mm, less than diameter of eye; diameter of tympanum less than diameter of eye, distance from tympanum to eye equal to about one-quarter diameter of tympanum. Digital discs present, very large, that of digit two the largest and equal to about three-quarters the size of the tympanum. Fingers relatively long, unwebbed, 2-1-3-4 in order of decreasing length. Toes long, with vestigial webs between all digits, 4-3-5-2-1 in order of decreasing length. Heels overlap strongly when hindlimbs held at right angles to body axis. Dorsum very finely and uniformly rugose, with fine raised dorsolateral folds, a raised supratympanic bar, an accessory longitudinal fold which arises in the scapular region and progresses thence down the side to parallel the dorsolateral fold for about half its length, and a group of warts at the angle of the jaws. Throat and chest smooth; belly smooth to slightly granular; abdominal disc fairly prominent, delimited anteriorly by a transverse inconspicuous pectoral fold and posteriorly by a more prominent transverse abdominal fold. Posterior surface of thigh with many small low rounded granules.

Vomerine teeth in two short, straight, slightly diagonal series, separated from each other by a distance equal to one-third of one row, overlapping the median margin of the choanae very slightly, and separated from them by a distance equal to about

one and one-half times the diameter of a choana. Tongue large, ovoid, slightly nicked, free behind, and equal in area to about two-thirds the floor of the mouth.

Snout and intertympanic area in life tan with a brown interocular bar, sharp-edged anteriorly and diffuse posteriorly; a middorsal band, bounded on either side by the thin dorsolateral folds, tan overlaid with dark brown, with a dark brown pair of sacral spots just visible; other dorsal dots slightly paler brown and about the same color as the dark interocular bar; scapular crescents absent, but a few raised scapular warts forming a faint V (which is emphasized by being the line of transition between the tan intertympanic coloration and the darker middorsal zone coloration); sides very dark brown with no indication of lateral spotting (Fig. 5); lores dark brown without a preocular bar or pale area; supratympanic black line conspicuous and outlined above with a fine white line. Thighs and crura brown with about five transverse bars on the former and three complete bands on the latter; shadow-bars virtually absent. Concealed surfaces brown and unmarked proximally, black with cream vermiculations distally. Soles of feet very dark gray, all metatarsal tubercles except the inner one are gray; all are prominent, except the outer one, which is low and inconspicuous. A pair of chevron-like antebrachial bars which are quite conspicuous even against the dark ground color of the arm. Ventral ground color cream in life, with brown stippling on the chin and lower jaw. Underside of limbs creamy, sharply set off from the dorsal ground color, especially laterally, by a clear-cut dark brown zone along the outer face of the erus.

Variation: The measurements and ratios of twenty-seven specimens (type and paratypes) are: snout-vent length, 51.0 (47.3-54.4); head length, 19.7 (18.9-20.9); head width, 21.2 (20.2-22.7); tympanum, 3.8 (3.3-4.2); eye, 6.9 (6.2-7.5); naris to eye, 6.3 (5.7-7.0); femur, 26.0 (24.5-27.6); tibia, 29.8 (27.8-31.3); fourth toe, 24.4 (22.7-25.7); tibia/snout-vent length ratio, 58.4 per cent (55.7-61.3 per cent).

All specimens are like the type in general pattern, i.e., there is a median dorsal zone (pinkish-buff to dark brown), delimited laterally by the yellow dorsolateral folds, which is paler than the sides, but darker at least than the tan to reddish tan snout anterior to the interocular bar. In some individuals the interocular bar separates the two dorsal colors rather than having the intertympanic region the same color as the snout, as in the type.

The sides are uniformly darker than the dorsal zone, although in two cases the entire animal is presently a pale tan rather than a dark brown. Even in these two pale frogs the sides are darker than the dorsum. The dorsal spotting varies from present to absent (at least obscured); the scapular crescents, which are absent in the type, are present in a few specimens, and the sacral spots are usually discernible, although at times they too have disappeared. The supratympanic line is black and is always outlined above in white, thus rendering it doubly conspicuous. The concealed surfaces of the thighs are variable also; the type shows the usual condition, although in some specimens the pale pinkish-buff to creamy yellow areas form vertical bars on the distal portion of the thigh; in no case are there actual dots or pale marblings. Although the ventral surfaces are immaculate cream there is a variable amount of gray stippling on the lower jaw and throat, and the underside of the hindlimbs may have additional dark pigment at the area of the knee. The ventral limb pigmentation never reaches an extreme condition of darkening as in *E. r. aporostegus*. The iris is golden above, brassy below.

The enlarged digital discs are a conspicuous structural feature of all specimens. The abdominal disc is usually well defined.

Comparisons: The much greater bulk of *E. hypostenor*, as well as the enlarged discs and greater size, at once distinguish it from all the races of *ruthae* except *tychathrous*, which exceeds *hypostenor* in size but has very small digital discs. The dorsal pattern of *hypostenor*, and especially the pair of antibrachial chevrons, is like that of no race of *ruthae*. The tibia/snout-vent ratio in *hypostenor* averages greater than that of any subspecies of *ruthae*, and is overlapped only by that of the nominate form of *ruthae*; the higher ratios of *hypostenor* are statistically significant.

E. hypostenor in general appearance bridges very nicely the gap between *E. ruthae* and *E. inoptatus*. In fact, inspection of specimens of these three species confirms the suspicion that *hypostenor* may be closer to *inoptatus* than to *ruthae*. The dorsal pattern of *hypostenor* is much more like some dorsal patterns of *inoptatus*, but the "hidden" *ruthae* pattern elements — the scapular crescents and the sacral spots — are present but much subdued. It is almost as if *hypostenor* were combining, with some modification, the general pattern features of *ruthae*

and *inoptatus*. *E. hypostenor* does not reach the extremely large size of *inoptatus* (largest recorded size, 88 mm snout-vent; Shreve and Williams, 1963:304), lacks the spine-like upper eyelid tubercle, and has flat and dark brown (unicolor), rather than concave and variegated, lores. The two species resemble each other in having two antibrachial chevrons, although these are regularly less prominent and definite in *inoptatus*, and in crural crossbanding, although again in *inoptatus* this is not so diagrammatic as in *hypostenor*. The digital discs in *hypostenor* are relatively larger than in *inoptatus*, and the head appears longer and with a slightly more overhanging snout. The venter of *inoptatus* is distinctly granular, that of *hypostenor* smooth to slightly granular.

Observations: All but two of the large series from 10.5 miles south of Cabral were taken from earthen cavities in and about a mountain *cafetal* on the upper slopes of the Sierra de Baoruco at an elevation of 3500 feet. The two exceptions were found hopping on the ground in the same *cafetal*. As noted in the introduction, the burrows were at this locality in open situations among the coffee trees, although one was adjacent to a roadside log. The frogs from the other localities were from similar coffee stands, and the penetrating voice, a single noted "wherp," resounded through the wet groves at night. The single note was sometimes repeated as many as three times in succession, followed by a period of complete silence; in quality the "wherp" call is very reminiscent of the sound made by humans while regurgitating.

DISCUSSION

Eleutherodactylus ruthae is widespread in the República Dominicana and likely has a comparably wide distribution in Haiti. It seems to occur in rather isolated colonies. In many areas we listened for calling males under optimum weather conditions without success. An example of such a locality is the region to the south of Sabana de la Mar, where lowland forest and cacao groves offer excellent habitat for this species; this locality is only about 40 kilometers west of the Miches region, where *ruthae* was taken, and between Miches and the Península de Samaná, where the frog is probably abundant. Again, although the region about Higüey has suitable areas for *E. ruthae*, we encountered it only on the limestone ridge which parallels

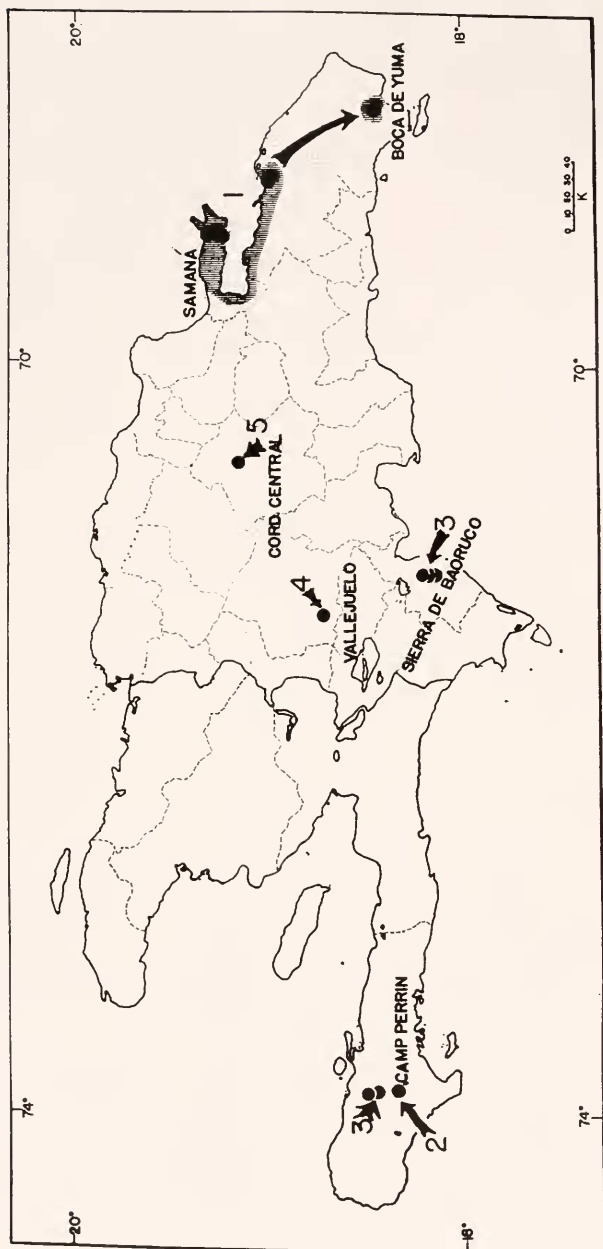


FIG. 6. Map of Hispaniola, showing distribution of *Eleutherodactylus hypostenor* and of the races of *E. ruthae* as follows: *r. ruthae*, 1, vertical lines (range discontinuous); *r. aporostegus*, 2; *hypostenor*, 3 (range discontinuous); *r. tychathrous*, 4; *r. bothroboans*, 5.

the coast at Boca de Yuma. In the uplands we did not encounter it in the Constanza area nor elsewhere in the high pine-woods, nor in the lowlands near La Vega and Bonao; however, it was fairly common but scattered in the pinewoods on the northeastern slopes of the Cordillera Central. I noted previously the absence of this species from the uplands of the Massif de la Selle and Massif de la Hotte, while *E. hypostenor* does occur in the Sierra de Baoruco, and *E. ruthae* occurs in the southern foothills of the La Hotte. In six weeks intensive collecting in the Port-au-Prince region, we never heard this frog nor had it brought to us by natives; at Camp Perrin we encountered it only in one locality. It is of course possible that there are small and localized colonies of *E. ruthae* throughout the whole Tiburon Peninsula area and even near Port-au-Prince; future collecting in these areas may well reveal some interesting material.

In the ranges to the north of the Valle de Neiba, we heard scattered calls in the Sierra de Neiba (northern range) south of Elías Piña in a coffee grove; the night was dry and the males were calling very infrequently. Probably these frogs were *E. r. tychathrous* since the type locality of this subspecies is farther to the east in the northern foothills of the Sierra de Neiba. Near Sosúa on the north coast of the República Dominicana, a single male was heard in the limestone hills southeast of the village, but was not collected. These are the only localities where we heard the species and did not succeed in securing at least one example.

The distribution of the species *ruthae*, then, appears to be disjunct (although this may be an artifact of collecting), and the frog is now known to occur in the following regions (see Fig. 6): 1) *r. ruthae*—Península de Samaná south and east along the south shore of the Bahía de Samaná and to Boca de Yuma (although even in this range the frog is not continuously distributed in suitable habitat and the map shows the range as disjunct); 2) *r. aporostegus*—the southern foothills of the Massif de la Hotte at Camp Perrin; 3) *r. tychathrous*—at least the northern range of the Sierra de Neiba; 4) *r. bothroboans*—the northeastern pine-clad slopes of the Cordillera Central.

The presumed occurrence of the related *E. hypostenor* throughout the Tiburon Peninsula and in the Sierra de Baoruco on the Península de Barahona makes it possible to postulate that in *E. ruthae* and *E. hypostenor* we have two burrowing

frogs which are geographic cognates of one another, the former a north island species which has secondarily invaded the south island and has extended as far as the tip of the Tiburon Peninsula, and the second a typically south island species. *E. hypostenor* has evolved less from the parent stock (assuming that it and *E. inoptatus* are closely related) than has the more specialized *E. ruthae*.

Noble (1923:6) suggested that *E. ruthae* is related to *E. inoptatus*; Cochran (1941:33) agreed with this relationship, and mentioned as characteristics common to the two species the "essential color pattern, . . . presence of a dorsolateral fold and a subsidiary diagonal row of glands on the sides, and in the relative proportions of the toes." The two frogs are quite different species; the shovel-shaped snout of *ruthae* and the supraorbital spine of *inoptatus* serve to differentiate the two forms with ease. Judging only from Samaná specimens of *ruthae*, this relationship seems far distant; no *inoptatus* which I have seen has a pattern of dorsal spots, for example, and

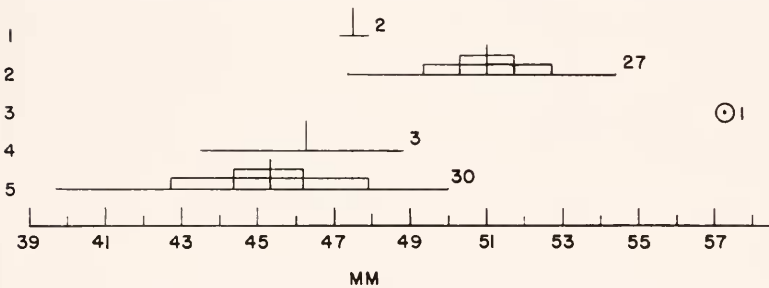


FIG. 7. Subspecies of *Eleutherodactylus ruthae* and *E. hypostenor*, showing variation in snout-vent lengths of males; low rectangles include one standard deviation, high rectangles include two standard errors of mean. Number of specimens follows horizontal line which represents range of sample; mean is shown by vertical line. Samples arranged as follows: 1) *aporostegus*; 2) *hypostenor*; 3) *tychathrous*; 4) *bothroboans*; 5) *ruthae*.

inoptatus reaches a far larger size than *r. ruthae*. The habitus of the two animals is different; *inoptatus* is a large-headed, long-legged frog whereas *r. ruthae* is small, sharp-snouted, rather small-headed, and not so long-legged as *inoptatus*. As pointed out previously, *E. hypostenor* neatly bridges the gap between the two species. It is long-legged (like *inoptatus*), is patterned with

a typical *inoptatus* pattern, but has the hidden *ruthae* pattern and calls from underground in the manner of *ruthae*. Despite the obvious differences of *ruthae* and *inoptatus*, I feel that they, through *hypostenor*, are indeed closely allied.

Shreve and Williams (1963:318) assign *inoptatus* to their *varians* group; I see no special advantage for changing the name of this group (which Dunn originally called the *auriculatus* group, a name which I have maintained despite the fact that the name *auriculatus* is no longer used for the same frog as it was at the time of Dunn's usage) and continue to refer to this assemblage of frogs as the *auriculatus* group. The frogs which have been assigned to this group consist of arboreal, small to moderately sized frogs, which have granular venters, small vomerine tooth series (usually almost patch-like), and greatly enlarged digital discs. Incidentally, although this is not customarily given as a character of the group, all members have a single gular vocal sac which is unusually large for the size of the frog. All members call from trees, vines, grasses or shrubs, and thus are not associated with terrestrial calling sites. The calls are likewise characteristic, and will be discussed in a shortly forthcoming paper.

To associate *inoptatus* (and *ruthae* and *hypostenor*, if we regard them as related to *inoptatus*) with this compact group of small to moderate sized frogs with very specific habits, vocal sac structure, and voice, I feel is inappropriate. *Inoptatus*, *ruthae* and *hypostenor* together have granular bellies (although the bellies of *ruthae* and *hypostenor* may often be weakly granular or almost smooth), enlarged discs (although of the *ruthae* races only *bothroboans* has discs which are in any way comparable to those of *inoptatus* or *hypostenor*), and short vomerine series (although these series in both species are rather long, and hardly patch-like). These characteristics ally these three frogs more or less with the *auriculatus* group, although the parenthetical notes above indicate how they differ from more orthodox members. It might be necessary then to redefine the *auriculatus* group to include the variants of these three species.

However, in one major character neither *inoptatus*, *ruthae* nor *hypostenor* agree with other *auriculatus* members. *E. ruthae* has a very distinctive feature in the double vocal sacs, a condition which is found in West Indian *Eleutherodactylus* only in the Puerto Rican *E. karlschmidti* (which is not related to this assemblage). As far as *inoptatus* and *hypostenor* are concerned,

there appears to be no vocal sac, a condition usual for more advanced members of the genus in the West Indies (i.e., the *ricordi*, *dimidiatus*, and *symingtoni* groups in Cuba). It is of course conceivable that *inoptatus* represents a gigantic member of the *auriculatus* group which has secondarily lost the vocal sac, and *ruthae* a large member of the group which has developed a double vocal sac. The voices of *inoptatus*, *ruthae* and *hypostenor* are likewise not comparable to those of the *auriculatus* members; the voices of *ruthae* and *hypostenor* have been discussed in the present paper. That of *inoptatus* is a single bark or snore, which is repeated regularly and continuously at well spaced intervals. The voices of *ruthae*, *hypostenor*, and *inoptatus* are quite different from the voices of *auriculatus* group members, where the voice ranges from a single metallic note to a telegraphic series of clicks, with intermediate conditions represented by various

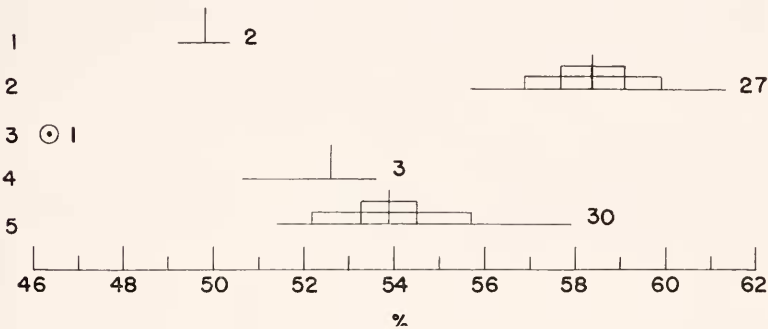


FIG. 8. Distribution of tibia/snout-vent length ratios by subspecies of male *Eleutherodactylus ruthae* and male *E. hypostenor*; horizontal line shows range of ratio, mean is vertical line, rectangles as in Figure 7. Samples coded and number of specimens as shown for Figure 7.

species. Additionally, *ruthae* and *hypostenor* call from subterranean burrows, and *inoptatus* calls from the ground or from low shrubs, vine tangles, or even from trees (coffee) at only moderate elevations above the ground (eight to ten feet). Although the latter situation is arboreal in a strict sense, one has the impression that this site for *inoptatus* is not the customary one. In any event, of the three species, only *inoptatus* approaches the truly arboreal calling sites of the remainder of the *auriculatus* group.

In the light of the foregoing, I feel it best to separate *E. inoptatus*, *E. ruthae*, and *E. hypostenor* from the *auriculatus* group, and assign them to a separate group, the *inoptatus* group, which will thus contain only these three species. I know presently of no other frogs in the West Indies which may with confidence be placed with them. When more information has been gathered on West Indian *Eleutherodactylus*, it is probable that relationships between the various groups will be clarified. At present, just as with the two members of the *symingtoni* group in Cuba (a pair of frogs which are large and quite different), I cannot form a conjecture about the origin of the *inoptatus* group. I may be maintaining too rigid an outlook towards membership in a particular group; this is especially true since Shreve and Williams have convincingly demonstrated annectant forms between several such assemblages. However, I think that with our present state of knowledge regarding Antillean amphibians, this is preferable to any sort of indiscriminate lumping without rather full knowledge not only of variation but also of life history data.

LITERATURE CITED

COCHRAN, DORIS M.

1941. The herpetology of Hispaniola. Bull. U.S. Nat. Mus., **177**:i-vii, 1-398, 12 pls., 120 figs.

LYNN, W. GARDNER, AND JAMES N. DENT

1943. Notes on Jamaican amphibians. Copeia, 1943 (4):234-242, 1 fig.

NOBLE, G. K.

1923. Six new batrachians from the Dominican Republic. Amer. Mus. Novitates, no. 61:1-6.

SHREVE, BENJAMIN, AND ERNEST E. WILLIAMS

1963. The herpetology of the Port-au-Prince region and Gonave Island, Haiti. Pt. II. The frogs. Bull. Mus. Comp. Zool., **129**(5): 302-342, 5 pls.